Five-Year Reviews

Presentation Overview

- Background
- Types of Reviews and Trigger Dates
- DON Role and Planning
- Five-Year Review Process
  - RAO Performance Evaluation
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- Report Sections
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  - Soil Vapor Extraction (SVE)
- Points of Contact
- References

Purpose

- Determine whether remedial action is protective or will be protective when complete
- Evaluate performance of remedial action
- Identify deficiencies, if any
- Recommend corrective actions

Don't Shoot the Messenger!

Don't Shoot the Messenger!

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Don't Shoot the Messenger!

Guidance/Policy

- DON Policy
  - Draft prepared in May 2001 for comments from EFDs/EFAs
  - Comments under review at CNO, as of August 2001
- U.S. EPA Comprehensive Five-Year Review Guidance
  - Final published in June 2001
  - More detailed than previous U.S. EPA guidance
  - http://www.epa.gov/superfund/resources/5year/index.htm

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Statutory CERCLA Five-Year Reviews

- Statutory reviews are required by law if **both** of the following conditions are met:
  - Contaminants will remain on site at levels that do not allow unrestricted use and unlimited exposure (UUUE), after completion of remedial action
  - ROD was signed on or after October 17, 1986
- These sites will have land use controls (LUCs) and will remain subject to statutory reviews

Statutory CERCLA Five-Year Reviews (cont.)

- Sites deleted from National Priorities List (NPL) may also require five-year reviews
- Presence of a single statutory review site at an installation makes all the sites at the installation subject to statutory reviews
  - Examples
    - Landfills
    - Slurry walls
    - Technical impracticability (TI) waiver sites
    - Stabilized waste sites

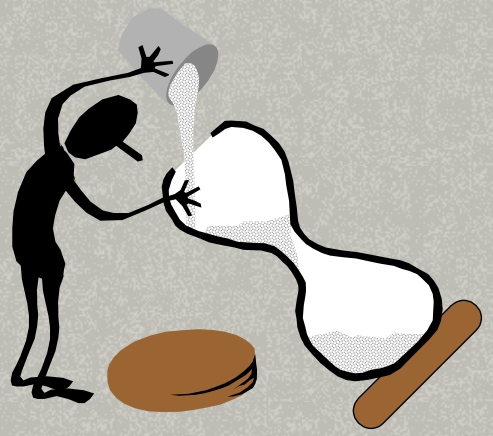
Policy Five-Year Reviews

- Policy Reviews
  - For sites where remedial action will remove contaminants to levels that will allow UUUE, and will require more than five years to complete
  - No LUCs after completion of remedial action
  - Examples: Contaminated groundwater sites under active or passive remediation that will achieve ARARs, such as MCLs
- **"DON generally does not conduct policy five-year reviews for its sites."** – DON Policy

Trigger Dates

When does clock start ticking for five-year review?

- For Statutory reviews:
  trigger date is on-site mobilization date
- For remedies not requiring on-site mobilization (e.g., MNA):
  trigger date is ROD or Interim ROD signing date
- For Policy reviews:
  trigger date is construction completion date
- U.S. EPA tracks these dates
- DoD also tracks these dates and sometimes suggests corrections to U.S. EPA database



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DON Role

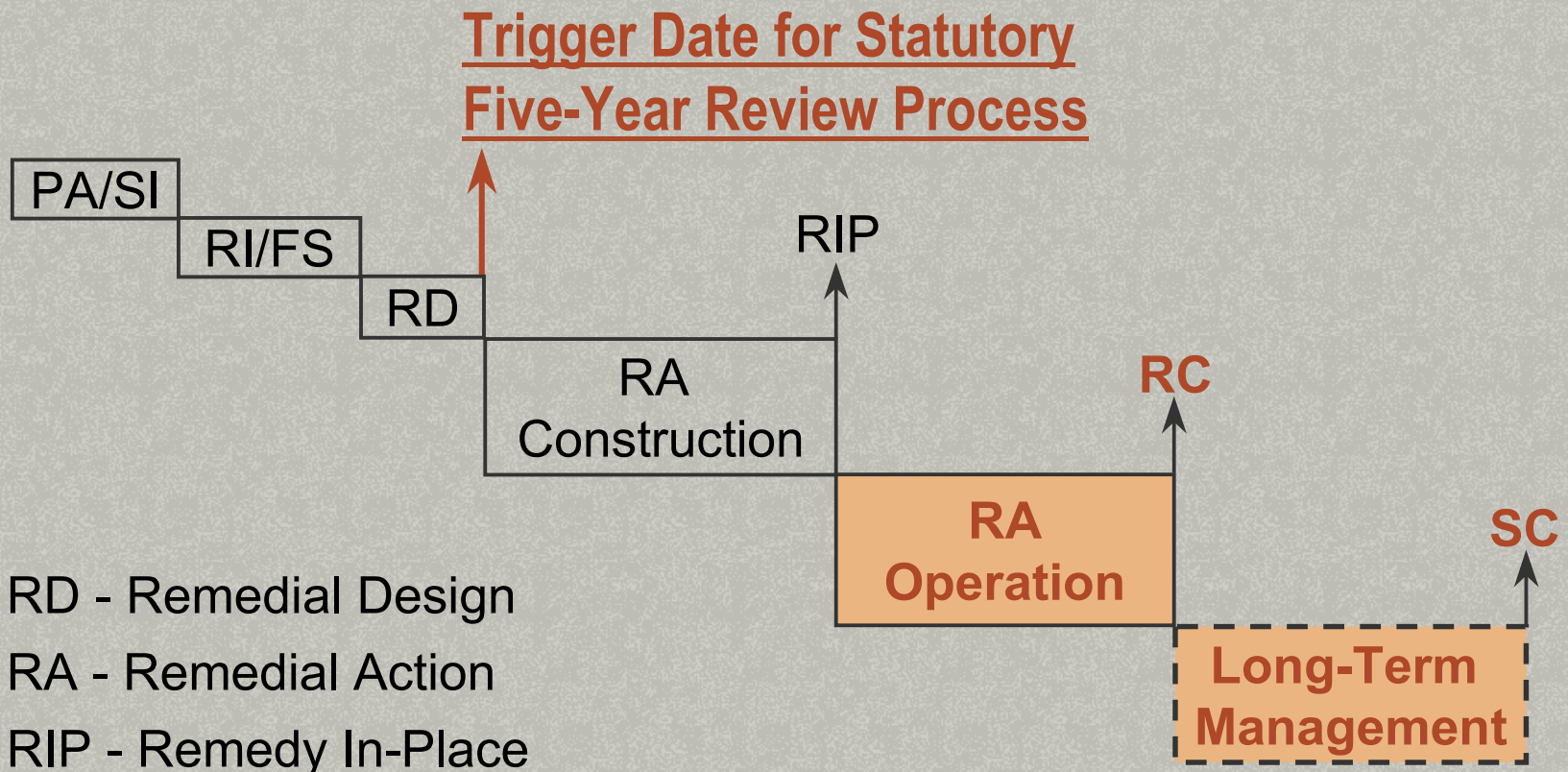
- U.S. EPA guidance document:
  - Provides detail about U.S. EPA role for DoD five-year reviews
- DON policy simplifies it:
  - DON responsible for conducting statutory review
  - Provide report to regulators for information only
  - Follow requirements from Federal Facility Agreement (FFA) or Federal Facility-State Remediation Agreement (FFSRA)
  - Future FFAs and FFSRAs are not to include five-year review reports as enforceable documents

Planning

- Review must be completed and signed prior to the five-year clock expiration
- Funding requirement should be included in budgets
  - Army cost estimate – $25K per site, $10K per additional site covered in the same report
  - For BRAC installations, responsibility for five-year review in accordance with transfer agreement
  - For active bases, NAVFAC to provide ER,N funds until five years after the last site achieves Response Complete (RC) milestone

→ **One five-year review after last RC**

IR Program Phases



RD - Remedial Design

RA - Remedial Action

RIP - Remedy In-Place

RC - Response Complete

SC - Site Closeout

Current Program Status

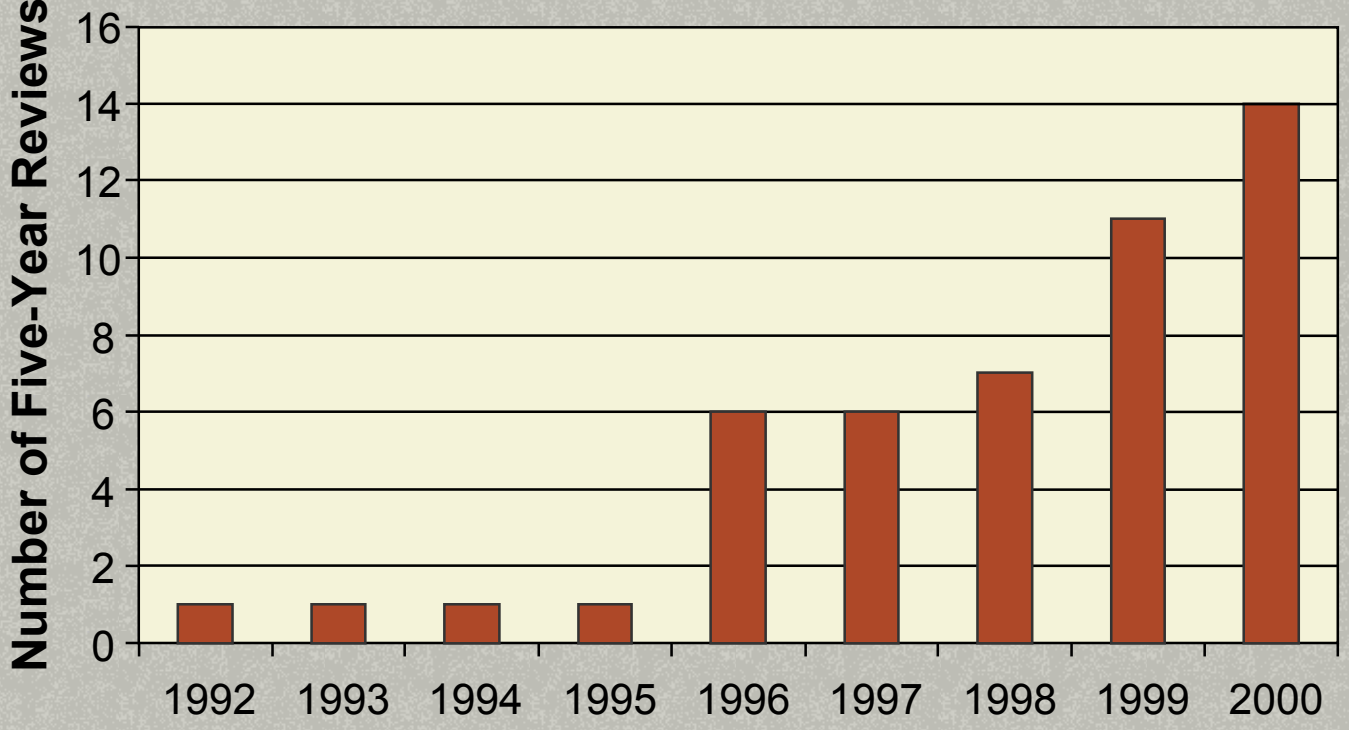
The percentage of sites with Records of Decision (RODs) and Remedy-in-Place is increasing; and the number of sites requiring five-year reviews is growing:

- Between 1992 and 2000, 669 five-year reviews were completed overall at NPL sites.
- DoD has 150* sites on the NPL with 45 five-year reviews completed by 2000.
- DON has 55 installations on the NPL, with 15 reviews between FY 00-03.

*Note: Based on Defense Environmental Restoration Program FY 1999 Annual Report to Congress.

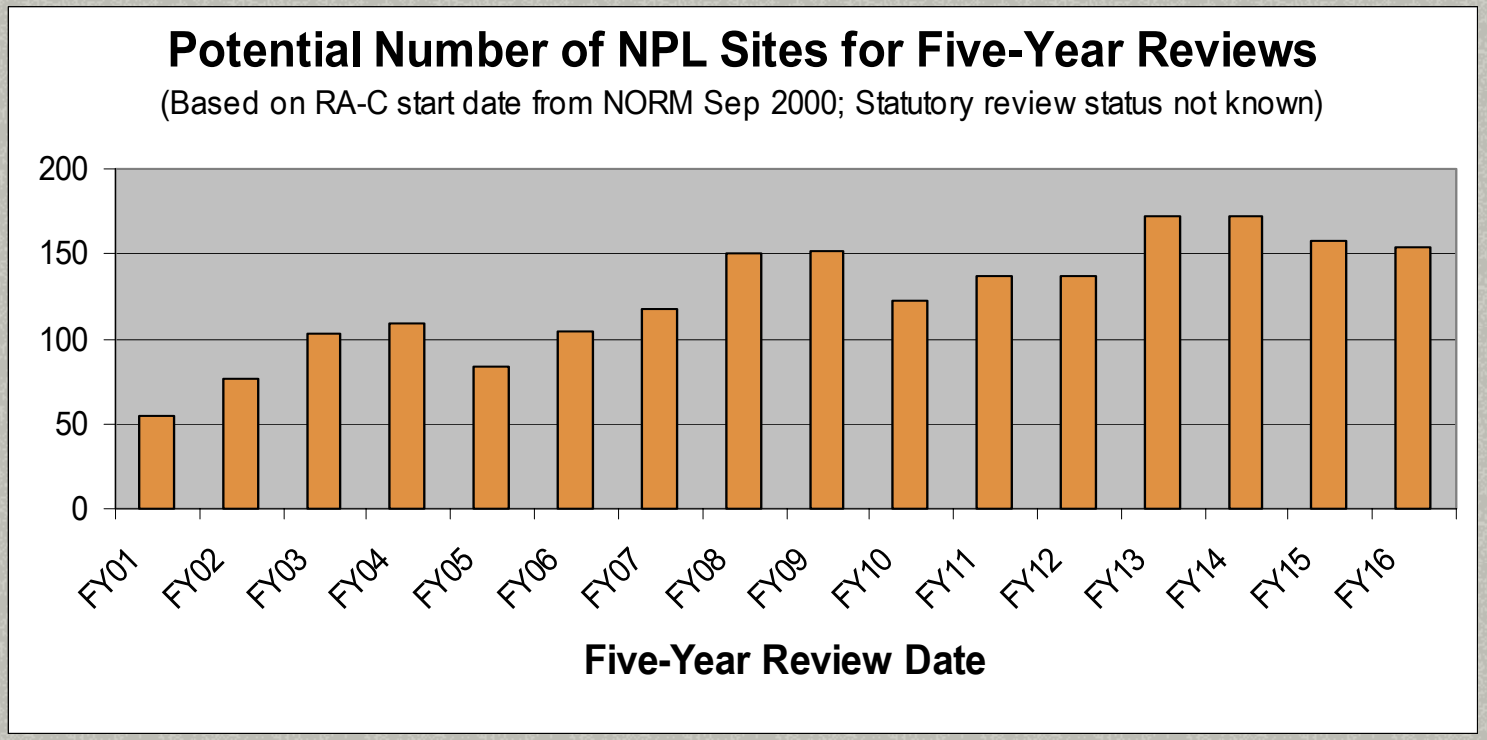
Current Program Status

Annual Number of Five-Year Reviews Completed at DoD Sites



DON Five-Year Review Sites

- 55 DON installations on NPL
- 1,748 sites on NPL installations
- 4,614 total DON sites



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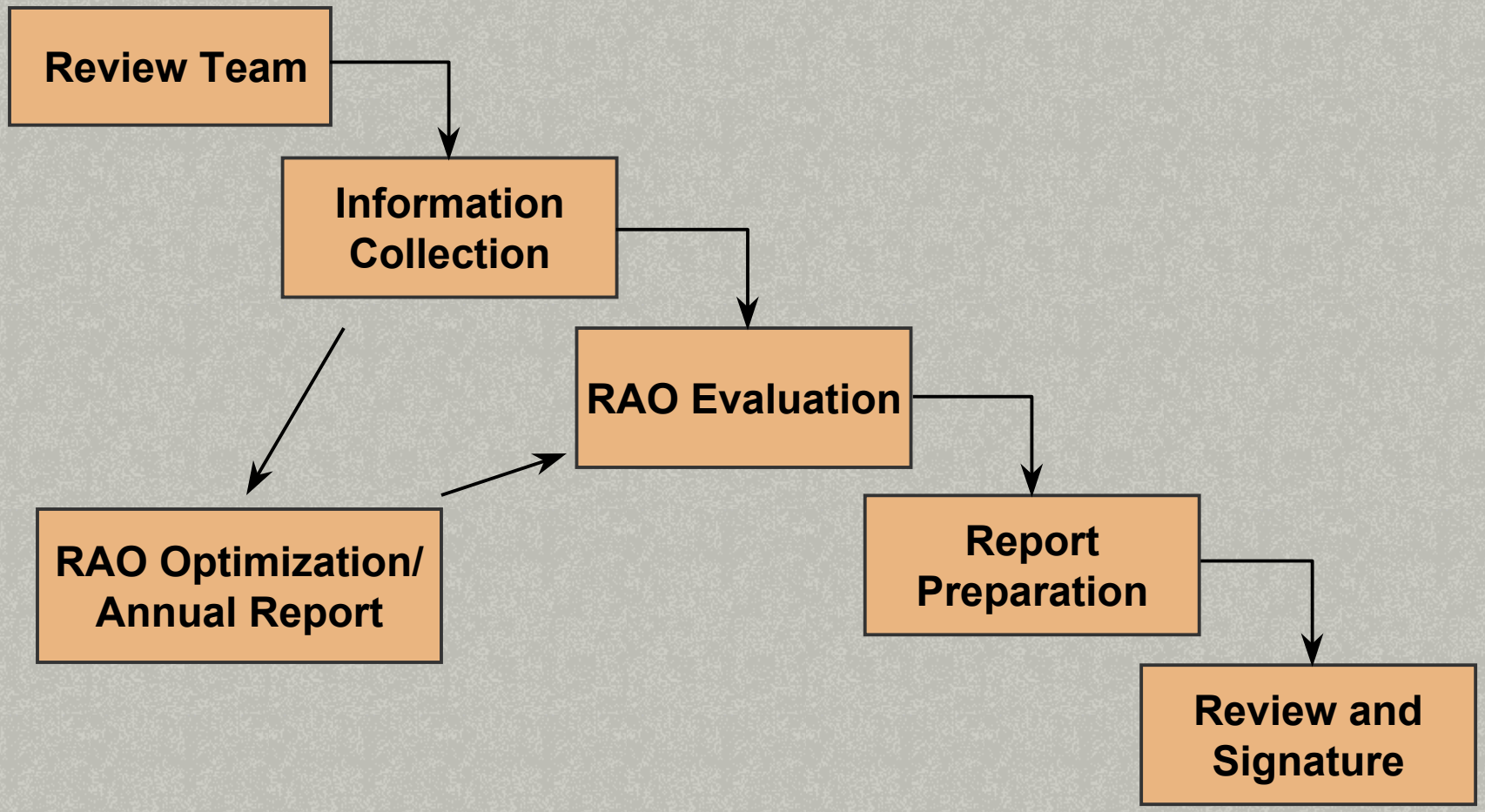
Five-Year Review Process



Remedial Action Operation (RAO) Evaluation

- DON Policy: RA evaluations are required to complete the five-year review
- Sites that have routine evaluation/optimization program could use these findings for five-year reviews
- RA evaluation to determine: Is remedy
  - Making progress toward cleanup goals?
  - Protective?
  - Capable of achieving cleanup goals?
  - Being effectively monitored?
  - Cost-effective?

RAO Evaluation (cont.)

- Evaluation process discussed in next few slides is based on case studies for optimizing RAO (DON Working Group)
- Chapters 4 and 5 of DON Guidance for Optimizing RAO cover RA evaluation in detail
  - http://enviro.nfesc.navy.mil/erb/erb_a/support/wrk_grp/raoltm/rao_interim_final2.pdf

RAO Evaluation (cont.)

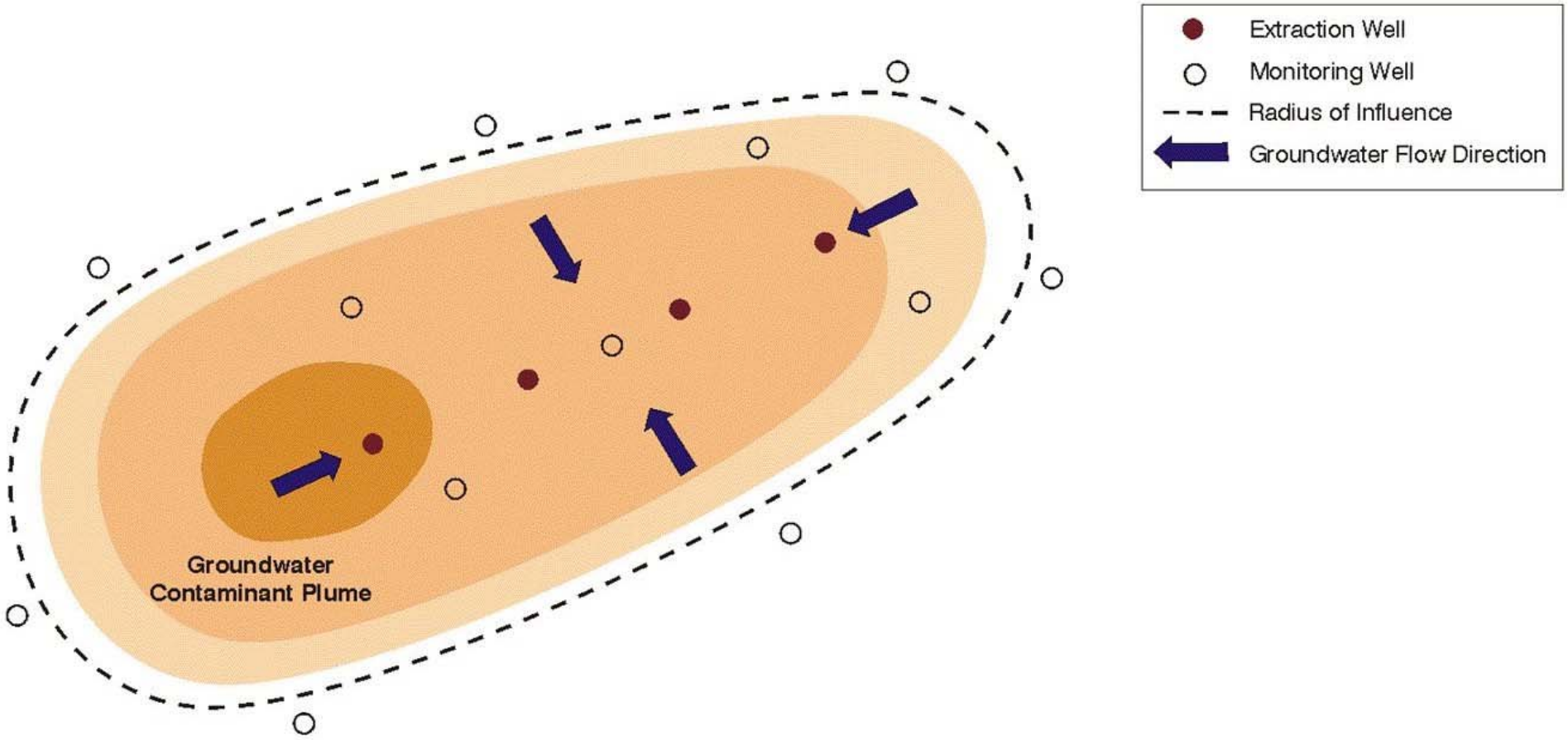
Does a definite trend indicate progress toward cleanup objectives?

- Need time series data analysis
  - Groundwater/soil contaminant concentrations
  - Groundwater level monitoring
  - System influent concentrations
  - Geochemical parameters
- Plume stable or shrinking?
- Subsurface contaminant concentrations trending downward?
- Sufficient mass removal?

RAO Evaluation (cont.)

- Verify remedial system operates as designed
- Example performance specifications:
  - Extract 100 gpm?
  - Treatment to nondetect levels?
  - 99.5% destruction removal efficiency?
  - 10 lb/hr total volatile organic compound (VOC) emissions?
  - 200 foot zone of capture?

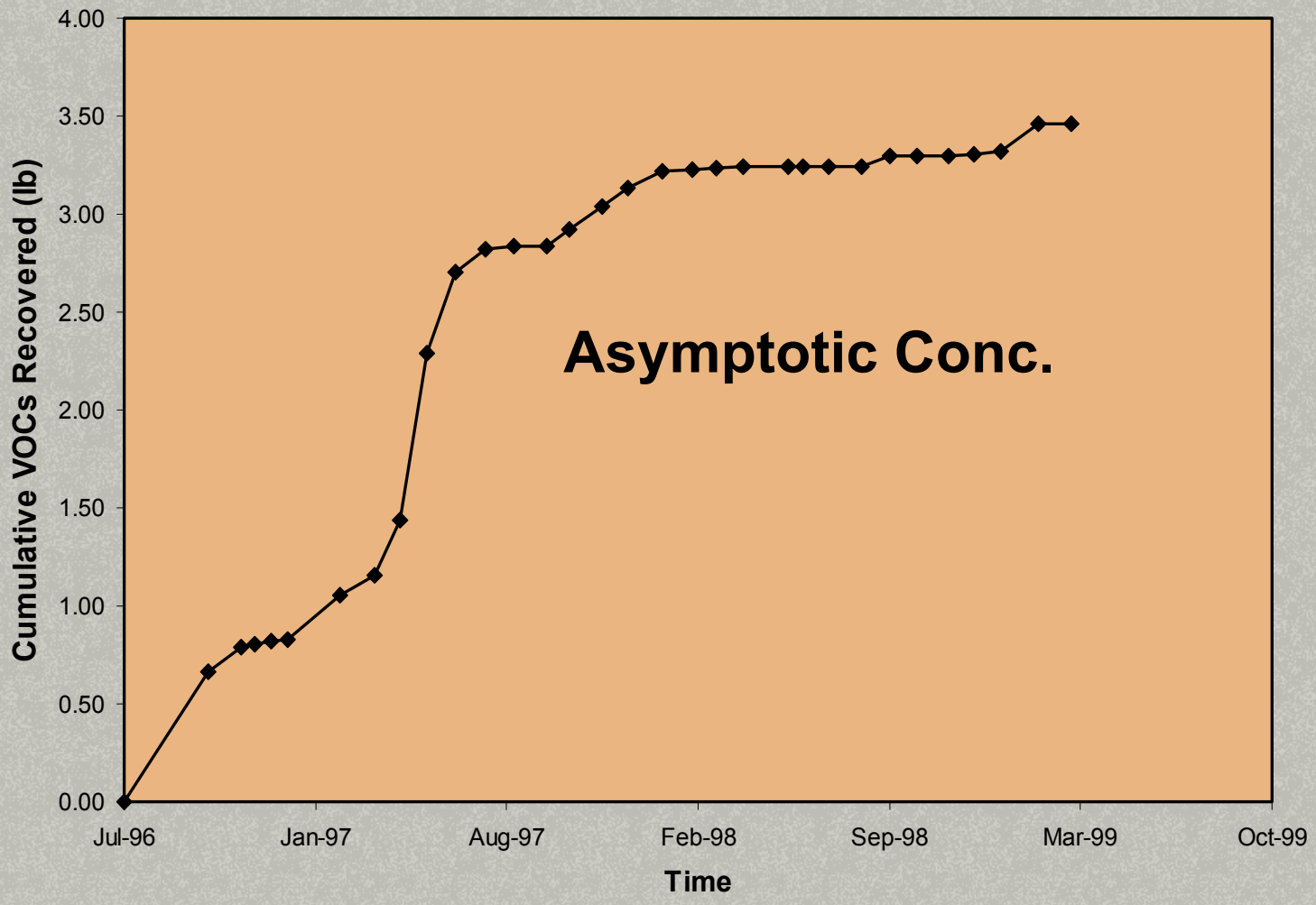
Capture Zone for Groundwater Pump-and-Treat



RAO Evaluation (cont.)

- Example data plots for system evaluation
  - Influent concentration vs. time (for aboveground systems)
  - Cumulative mass removed vs. time
  - Contaminant concentrations vs. time at selected monitoring wells
- Plume maps using GIS greatly improve data analysis

Performance Plot: Asymptotic Conditions



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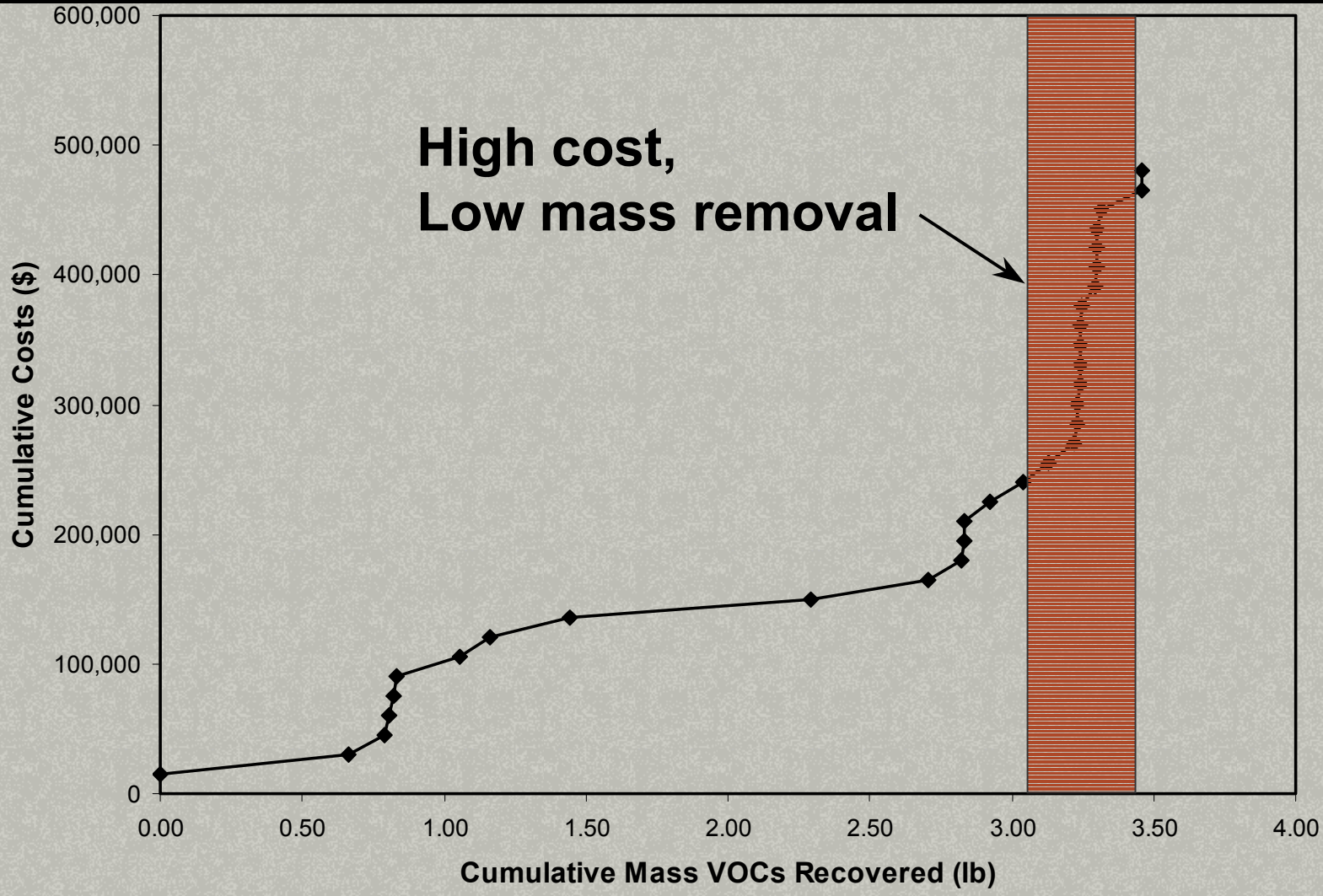
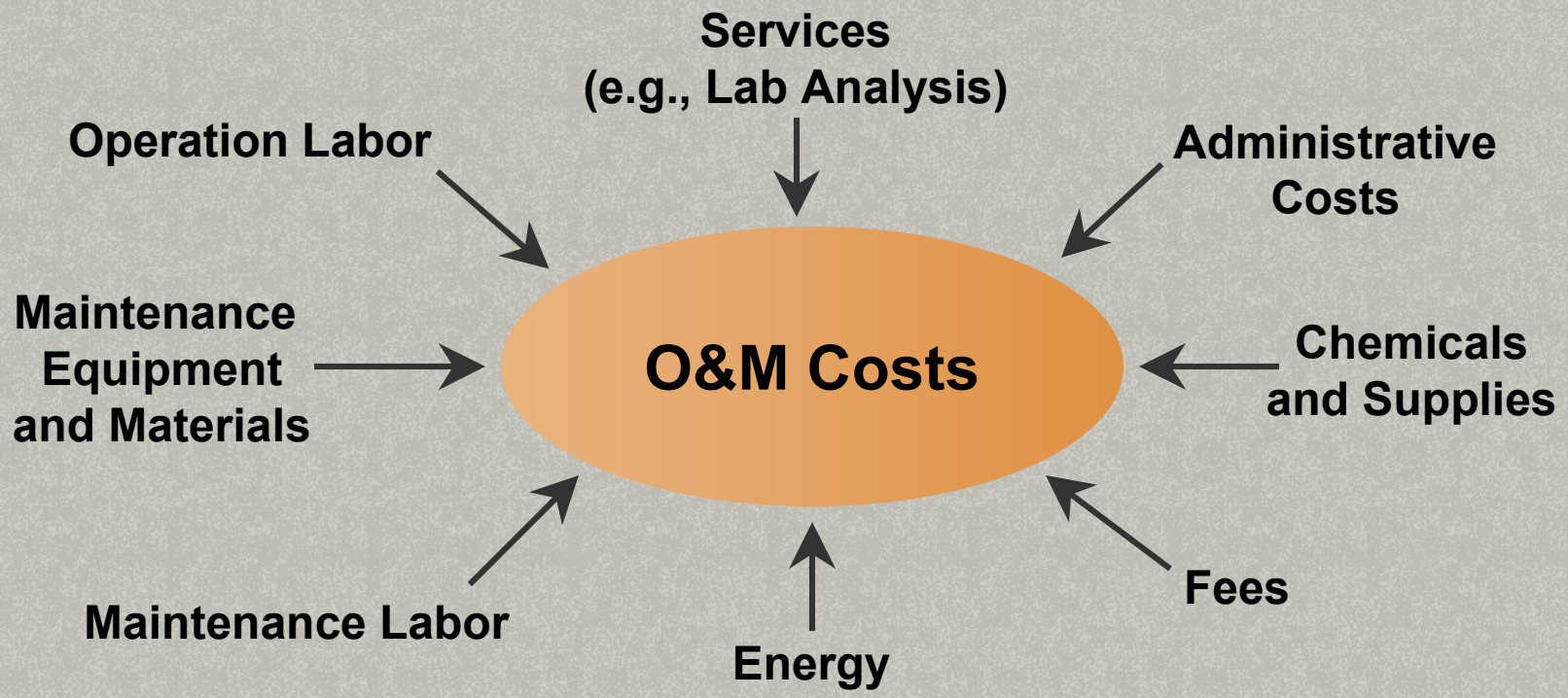
RAO Cost Effectiveness Evaluation

- Is contaminant removal cost-effective?
  - Plot cumulative mass removed vs. cumulative cost
  - Plot cost per unit mass removed vs. time
- Need to track operations and maintenance (O&M) costs
  - Are annual O&M costs decreasing?

Cumulative Cost for Contaminant Mass Recovery



Remedial Action O&M Costs



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Remedial Action Monitoring

- Number of monitoring wells should be adequate for:
  - Plume tracking
  - Hydraulic containment monitoring
- Monitoring frequency to be consistent with project goals –quarterly monitoring after a few initial years is generally not needed.
  - High monitoring frequency (e.g,. monthly) should be used for active remediation system influents to calculate mass removal rate
  - Passive remediation systems require less frequent monitoring

Remedial Action Monitoring (cont.)

- For list of monitoring parameters, focus on COCs instead of entire suites
- Field sampling procedures should be efficient (i.e., low-flow sampling, diffusion samplers, etc.)
- Plume dynamics may require additional new monitoring wells
- Consult the DON Guide to Optimal Groundwater Monitoring
  - http://enviro.nfesc.navy.mil/erb/erb_a/support/wrk_grp/raoltm/case_studies/lnt_Final_Guide.pdf

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Report Sections (from U.S. EPA Comprehensive Five-Year Review Guidance)

- Introduction
- Site Chronology
- Background
- Remedial Actions
  - Remedy description
  - Remedy Implementation
  - System O&M
- Review Findings
  - Interviews and site inspection
  - Risk information review
  - Risk recalculation/assessment
  - Data review
- Technical Assessment
- Deficiencies
- Recommendations and Follow-Up Actions
  - Identify milestones
  - Completion dates
- Protectiveness Statements
- Next Review

Example Deficiencies

- Remedy not properly implemented
- Remedy not expected to attain cleanup levels
- Early indications of potential remedy failure
  - Aquifer conditions
  - Excessive equipment replacement
- Sampling schedule not followed
- Inadequate maintenance
- LUCs violations

Protectiveness Statements

- Five-year review report must include statement about protectiveness of the remedy.
- Example: For groundwater remediation site with RA in progress:
  - "The remedy at OU-X currently protects human health and the environment. Institutional controls are in place to avoid use of site groundwater and the remedial action is effective in controlling groundwater from impacting any receptors."
- If a remedy is not protective, the statement must explain why the remedy is not protective and what actions (e.g., containment, institutional controls [ICs], etc.) will be taken to make it protective.

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Conclusions

- DON sites with contaminants above residential use scenario after RC milestone will have statutory five-year reviews
- A single statutory review site will subject entire installation to statutory reviews
- Trigger date is on-site mobilization for statutory reviews
- NAVFAC will fund five-year reviews until 5 years after the last installation site achieves RC milestone
- For sites that have RAO optimization programs, five-year review could use existing information on RA evaluation. For other sites, RA evaluation may require a significant effort for the five-year review.

Conclusions (cont.)

- Detailed procedures for RAO evaluation are provided in DON Guidance for Optimizing RAO.
- Five-year review report should be prepared and signed within five years from the trigger date.
- Report must include protectiveness statements. If deficiencies are present, the report must recommend corrective actions.

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Objective

Analyze completed five-year reviews from selected sites and evaluate the following trends:

- Is the remedy functioning as intended?
- Is the remedy protective?
- Are recommendations made to improve/optimize the remedy?

Five Year Review
Case Study Categories

- Pump-and-Treat (P&T)
- Soil Vapor Extraction (SVE)

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Groundwater Case Studies

- **P&T** was chosen as part of the groundwater remedy at the following sites selected for review:
  - CTS Printex Facility, CA
  - Fort Lewis Logistics Center, WA
  - Motorola 52nd Street, AZ
  - Pinette's Salvage Yard*, ME
  - DoD NPL Site 1, WA
  - DoD NPL Site 2, WA

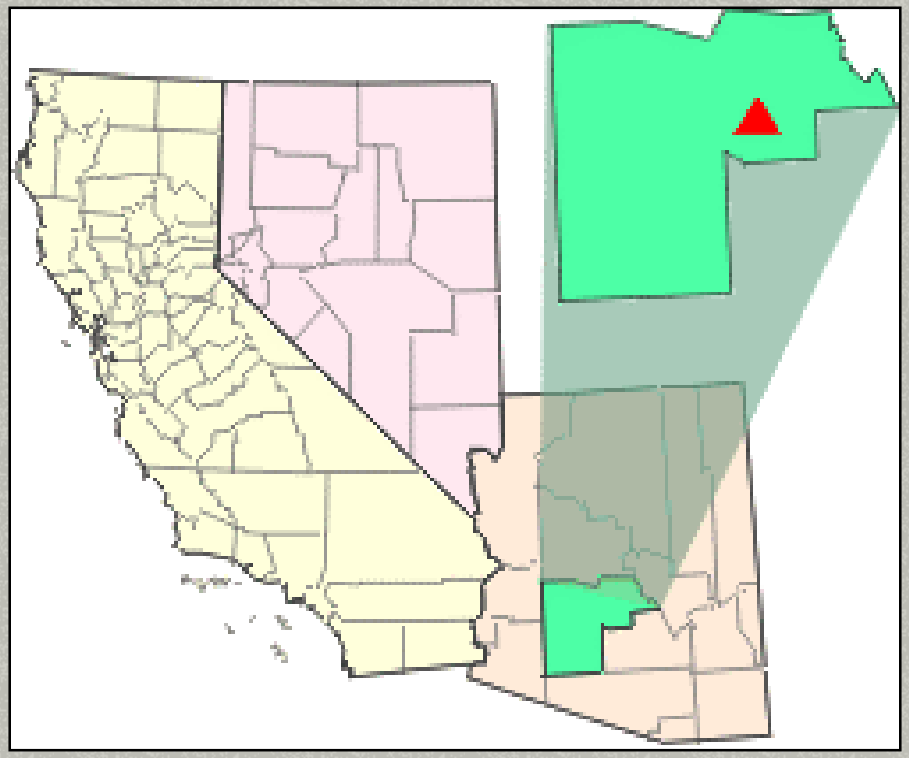
*Note: P&T was selected as remedy, but not implemented based on TI waiver.

Motorola 52nd Street Superfund Site Case Study

- Placed on NPL list in 1989
- Large site in the urban eastern part of Phoenix, AZ
- Four Operable Units (OUs) at site
- Five-Year Review for OU-1 in 1995

Motorola 52nd Street Superfund Site: OU-1

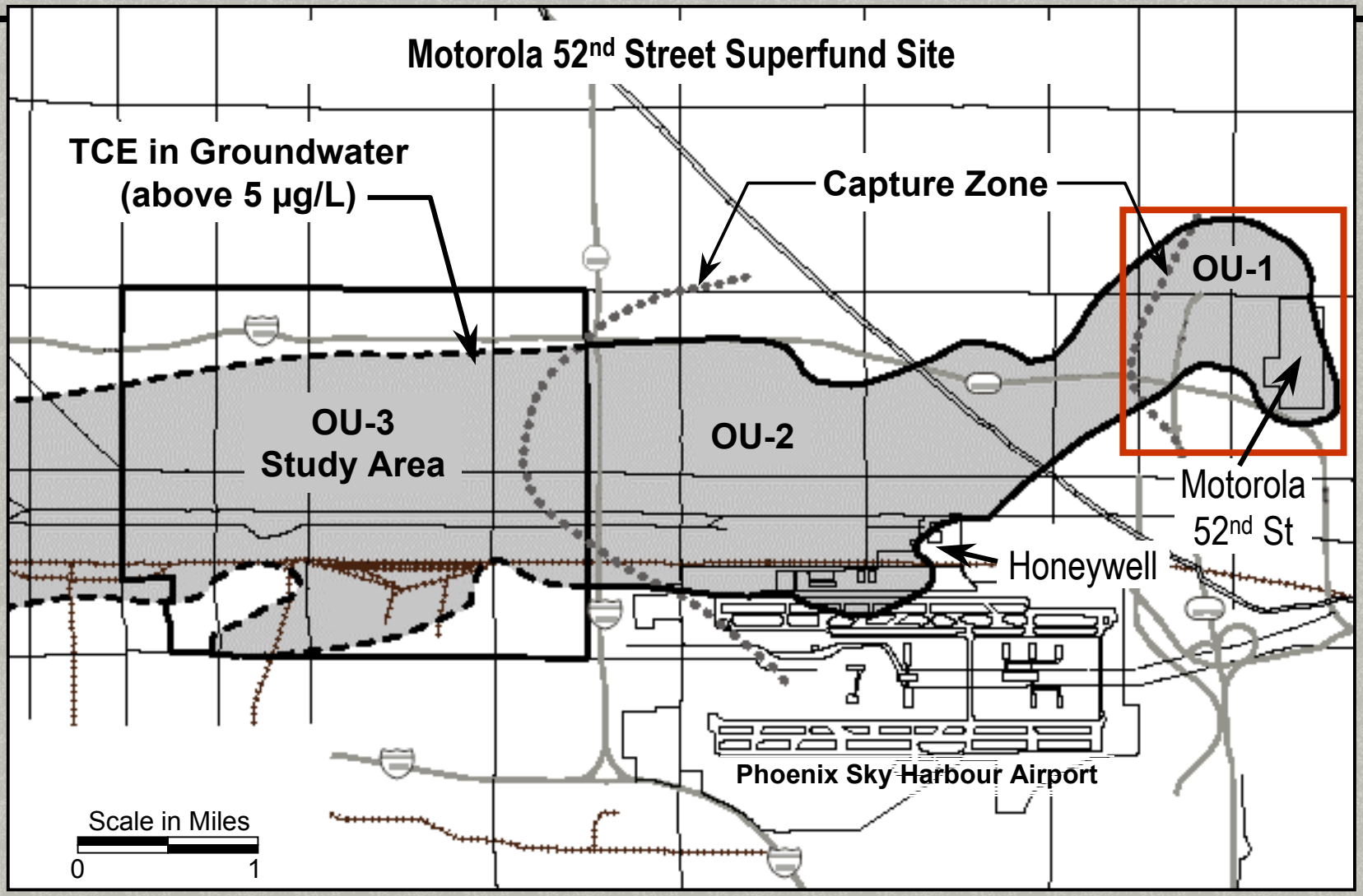
- Activities:
  - Manufacturing
- Compounds:
  - TCE and TCA
  - DNAPL present
- Contaminated Media:
  - Groundwater, soil
- Remedial Actions:
  - P&T, SVE
- Groundwater Cleanup Goals:
  - Not specified



Motorola 52nd Street Superfund Site: OU-1

- OU-1 covers groundwater and soil cleanup activities at the Motorola 52nd Street Plant.
- Groundwater several miles to the west of OU-1 is also contaminated and is covered under OU-2.
- RA objective is to prevent contamination from moving further west and to begin cleaning up the groundwater in the area.
  - Additional remediation will be conducted under a different ROD.

Superfund Site Map Showing Groundwater Contamination



Source: ADEQ

P&T System Parameters

Motorola 52nd Street Superfund Site

- Number of Extraction Wells: 24
- Design Flow Rate: 600 gpm
- Duration of Operation: 5 years
- Treatment System: Air stripping and GAC
- Groundwater Monitoring System:
  27 multi-level wells, 41 groundwater wells
- Treated groundwater re-used in manufacturing process

Is the Remedy Functioning as Intended?

Motorola 52nd Street Superfund Site

- Arizona Department of Environmental Quality (ADEQ) determined that the remedy was effective at reducing plume migration in the alluvial portion of the aquifer.
- ADEQ believed containment of the plume in the fractured bedrock portion of the aquifer was not established based on an increase in TCE from 8,100 to 20,000 µg/L in one well over three quarters of monitoring.
- U.S. EPA did "not share ADEQ's level of concern" and stated that "any leakage from OU-1 will have minimal additional impact. Further, the OU-2 containment system, when installed will probably capture any contaminants that elude the OU-1 system."

Protectiveness Statement

Motorola 52nd Street Superfund Site

"In general, ADEQ has determined that the remedy is effective in the alluvial portion of the aquifer. Containment of the contaminant plume in the bedrock portion of the aquifer is controversial."

Are recommendations made to improve/optimize the remedy?

Motorola 52nd Street Superfund Site

- Future plans for system optimization were not discussed in the five-year review.
- The five-year review stated that meetings had been scheduled to discuss plume containment in the fractured bedrock.

Summary of Groundwater Case Studies

- **P&T** was chosen as part of the groundwater remedy at the following sites selected for review:
  - CTS Printex Facility, CA
  - Fort Lewis Logistics Center, WA
  - Motorola 52nd Street, AZ
  - Pinette's Salvage Yard*, ME
  - DoD NPL Site 1, WA
  - DoD NPL Site 2, WA

*Note: P&T was selected as remedy, but not implemented based on TI waiver.

Summary of P&T Remedy Statistics

Site	COCs	Duration (yrs)	No. of Extraction Wells	Total Flow Rate (gpm)	Treated Groundwater (million gal)	Amount of COCs (gal / lb)	Cleanup Levels
DoD Site 1	RDX	2	5	10	NL	NL	MTCA
DoD Site 1	TNT, DNT, RDX, TNB	5.5	10	600	1,100	NL / 3,300	MTCA
CTS Printex	TCE, DCE, TCA, DCA	10	NL	NL	9	8.5 / 102	MCLs
Fort Lewis	PCE, TCE, DCE	2	20	2,800	NL	NL	MCLs
Motorola	TCE, TCA	5	24	600	736	1622 / 20,000	NL
DoD Site 2	TCE, DCE, VC, TCA, DCA	3	9	210	748	159 / 1,905	MCLs

Note:
1) RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
2) MTCA = Washington State Model Toxics Control Act (MTCA) Cleanup Levels

Is the Remedy Functioning as Intended?

The following trends were noted related to the overall functioning of P&T systems:

- Biofouling of extraction/injection wells caused periodic system malfunctioning.
- Low or asymptotic levels of contaminant recovery were often experienced.
- Inadequate source containment, especially in fractured bedrock, was an issue at some sites.
- In some cases, O&M costs were 2 to 10 times higher than estimated in the ROD.

Is the Remedy Protective?

The following trends were noted related to the protectiveness of P&T systems:

- All six sites set cleanup goals in ROD to meet federal or state maximum contaminant levels (MCLs).
- Four of six P&T systems were not anticipated to meet MCLs in groundwater.
- Two of six reviews stated that a TI waiver was appropriate because MCLs could not be met within a reasonable time frame and/or budget.
- Often, the remedy remained protective primarily because of institutional controls to prevent the use of the groundwater as a drinking water source.

Are Recommendations Made to Improve/Optimize the Remedy?

Issue	Potential Solutions
Biofouling of injection/extraction wells	• Stop re-injection, instead discharge treated water to stormwater pond for infiltration. • Use in-well hypochlorite injection systems to control problem in extraction wells.
Low or asymptotic contaminant recovery	• Optimize system with alternate pumping, pulse pumping, and/or additional wells. • Implement institutional controls on groundwater use. • Establish alternate cleanup levels (ACLs) based on off-site receptors and/or surface water discharge.
Inadequate source containment	• Optimize system with alternate pumping, pulse pumping, and/or additional wells. • Need for additional research into hydraulic containment in fractured media.
O&M costs higher than anticipated	• Investigate performance of wastewater treatment system. Stop use of oil-water separator or GAC polishing step, if feasible. • Direct discharge of air stripper off-gas may be feasible, depending on contaminant loading. • Use cost data to support TI waiver.
Remedy not functioning and/or not protective	• Consider Explanation of Significant Difference (ESD). Study use of alternate remedy such as monitored natural attenuation (MNA). • Submit TI waiver for remedy or for contaminant cleanup goals.

Lessons Learned

- P&T systems can achieve plume containment, but the inability of this remedy to meet groundwater MCLs is widely documented.
- Use of Explanation of Significant Differences (ESD) for remedy changes or Technical Impracticability (TI) waivers is a potential solution and was considered at three out of the six sites reviewed.

Lessons Learned (cont.)

- Institutional controls preventing use of groundwater are key to remedy protectiveness.
- Current emphasis of U.S. EPA and state regulators is on the development of formal procedures to verify and document proper implementation of institutional controls.

Lessons Learned (cont.)

- It is important to have adequate data on system performance, because significant decisions regarding remedy protectiveness will be made.
- As the Motorola case study showed, when there is a minimal amount of data, stakeholders can draw different conclusions from the information provided.

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Vadose Zone Case Studies

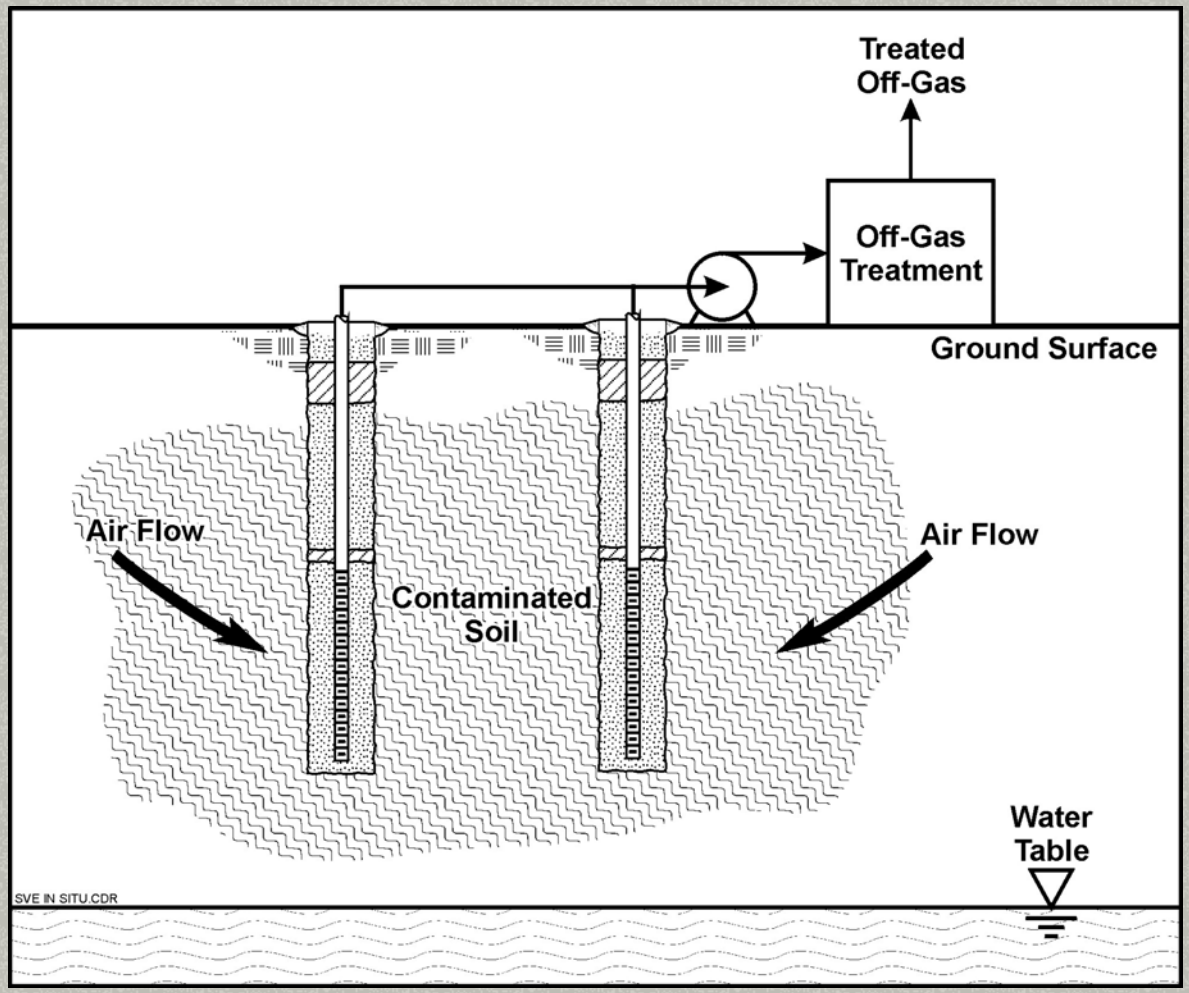
- **SVE** was chosen as part of the vadose zone remedy at the following sites selected for review:
  - Hastings Groundwater Contamination, NE
  - Motorola 52nd Street, AZ

Hastings Groundwater Contamination at OU-7, Site #3

- Placed on NPL list in 1984.
- Contaminated drinking water aquifer in the vicinity of Hastings, NE.
- Several source areas including a landfill, grain storage facility, railcar loading area, and other industrial sites.
- 20 OUs with multiple responsible parties.
- Five-Year Review of OU-7, Site #3 in 1997.

Hastings Groundwater Contamination at OU-7, Site #3

- Activities:
  - Grain fumigation
- Compounds:
  - Carbon tetrachloride
- Contaminated Media:
  - Groundwater, soil
- Remedial Actions:
  - SVE
- Soil Cleanup Goal:
  - Site-specific
  - SVE rate = 0.001 lb/hr



Hastings Groundwater Contamination at OU-7, Site #3

- Components of the selected remedy for vadose zone soils:
  - SVE and treatment of air emissions by GAC.
  - GAC to be transferred off-site for regeneration or incineration.
- Remedial action objective was to control the migration of carbon tetrachloride from the vadose zone to groundwater.

SVE System Parameters

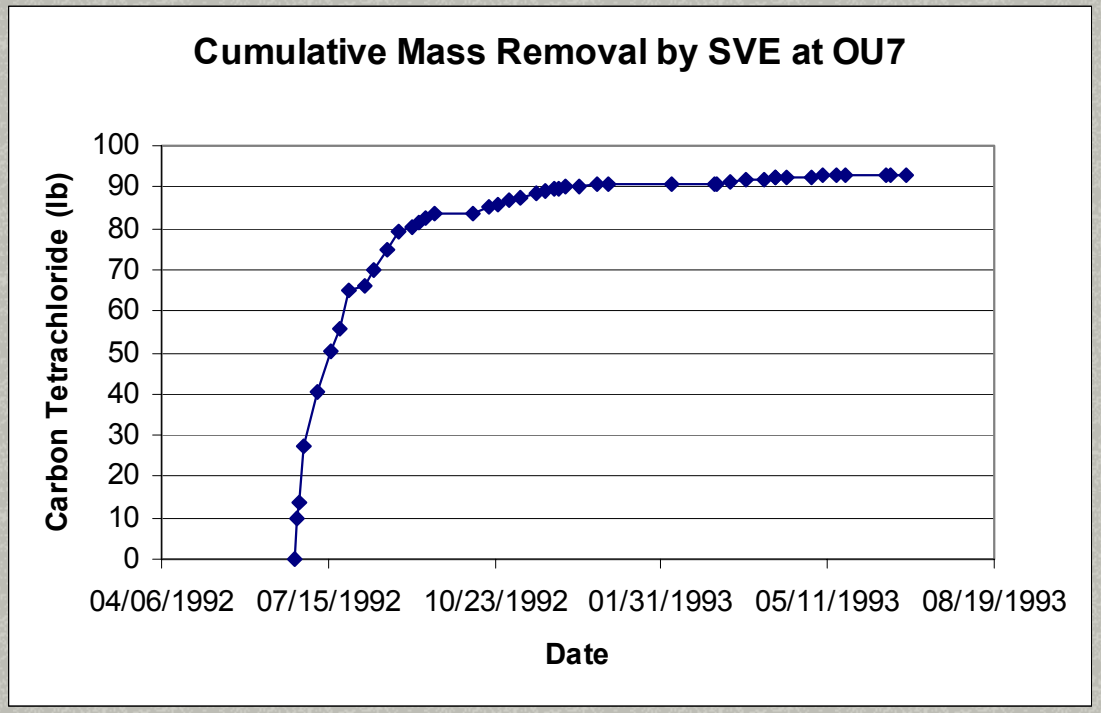
Hastings Groundwater Contamination at OU-7, Site #3

- Number of extraction wells: 3
- Screened intervals:
  - 50 to 80 ft bgs
  - 80 to 110 ft bgs
- Wellhead vacuum: 3 in. Hg
- Flowrate per well: 300 scfm
- Radius of influence: 100 ft
- Duration of operations: 1 yr
- Vapor treatment type: 1,000 lbs GAC

Is the Remedy Functioning as Intended?

Hastings Groundwater Contamination at OU-7, Site #3

- Initial soil vapor levels as high as 1,234 ppmv CCl_4.
- SVE mass removal ranged from 0.6 to 0.0001 lb/hr.
- System shutdown 2 months. No rebound.
- Diminished source. CCl_4 in groundwater decreased from 1,400 ppb to 25 ppb during SVE.
- The remedy was initiated in 1992 and completed in 1993.



Protectiveness Statement

Hastings Groundwater Contamination at OU-7, Site #3

"I certify that the response action for Operable Unit #07 selected for this subsite remains protective of human health and the environment."

Are Recommendations Made to Improve/Optimize the Remedy?

Hastings Groundwater Contamination at OU-7, Site #3

- The five-year review in 1997 found that the vadose zone remedy was protective, although no additional soil sampling was conducted at that time to confirm cleanup.
- The full-scale remedy for the on-site groundwater, P&T, was initiated in 1996 and will be reviewed as part of the five-year review for OU-13.

Lessons Learned

Hastings Groundwater Contamination at OU-7, Site #3

- Negotiate with regulators to set performance objectives to operate the SVE system while still cost-effective. At Hastings OU-7, the goal was set at reaching 0.001 lb/hr of VOC removal.
- It is best to operate the SVE system based on performance objectives such as asymptotic mass removal, declining soil vapor concentrations in monitoring points, and minimal rebound after shutdown.
- At Hastings OU-7, the period for monitoring rebound was 2 months. It is generally recommended that monitoring for rebound occur after a six-month shutdown period.

References

- DON Policy, Final published in September 2001(?)
- U.S. EPA Comprehensive Five-Year Review Guidance, Final published in June 2001
  - http://www.epa.gov/superfund/resources/5year/guidance.pdf
- DON Working Group RAO/LTM Optimization Website
  - http://enviro.nfesc.navy.mil/erb/erb_a/support/wrk_grp/raoltm/
  - Guidance for Optimizing Remedial Action Operations
  - Guide to Optimal Groundwater Monitoring
  - Optimization case studies